M E M O R A N D U M

April 17, 2000

To: URGWOM Technical Team
From: William J. Miller, Consulting Engineer
Subject: Technical Review Committee Comments on January 26, 2000 URGWOM Physical Model Documentation.

This Memorandum compiles and summarizes the major comments of some of the members of the Technical Review Committee on the January 26, 2000 URGWOM Physical Model draft Document. Minor editorial comments were make in a marked-up version of the document and are not included in this Memorandum. A brief description of how the comment was addressed or otherwise disposed of is provided following the comment. Page numbers in this document refer to pages in the January 26, 2000 document. Changes in addition to these have been made to the model and the documentation. The entire 2nd draft should be reviewed to determine current content of the document.

Document Organization

It is difficult to find major sections of the text document. For the sake of providing for more easy reference to parts of the document, it would be helpful to number each section, or utilize a chapter system.

The geographic scope of area covered by the document should be more fully described in the introduction. *The document has been revised to address this suggestion.*

Include a copy of the RiverWare topology or workspace layout at the beginning of each reach section for use in describing that section. *A copy of the RiverWare workspace showing the URGWOM river reaches has been added to the document.*

Page 1, streamflow routing methods. Provide additional basis or discussion for placing the "Routing and Losses" Section at the beginning of the document. *The routing and loss computation are major computations needed for the proper functioning of all of the River Ware models being developed for URGWOM.*

Include a description of the different types of models and data bases available within URGWOM. *The January 26, 2000 Documentation describes the URGWOM physical model documentation. The relationships developed in the physical model are also used in other URGWOM models, the accounting model, the planning model, and the water operations model. Discussion of these models is beyond the scope of this Document.*

Show the Sevillita National Wildlife Refuge and the Bosque del Apache National Wildlife Refuge in Figure 6. Maps have been revised to incorporate these features.

Page 23, section “Description of Physical …” In the text, dams were used for Table 31, however, reservoirs were used in the title of Table 31. Should the Table title be written as “ Table 31. General information about dams in the Rio Chama Basin”? *The document has been revised in accordance with this suggestion.*

Ensure that the format for all references is consistent. *The references section of the Document has been reviewed and revised for consistency.*

It would be helpful to include in the Maps on pages 8, 25,29, and 30, some sort of indicator that would show the boundaries of the URGWOM reaches. The map features have been modified to reflect URGWOM river reach boundaries.

Technical or numerical

Page 2, Table 1, delete the units descriptor “(cfs x 10^3)” from the column headed “Flow Rate”. *This heading has been edited in accordance with this suggestion*.

The time lag in Figure 2 to the nearest 0.00 hours is not appropriate for a log-log plot. *The graph has been edited as suggested*.

It is probably not necessary for all tables and graphs to show four significant figures in the coefficient of determination. *The Tables have been edited to show this value using two significant figures.*

Page 21, paragraph below Table 27, the meaning of the sentence “January data show a 27-percent loss of flow…” is not clear. Is there really a loss of flow? Please clarify and make the reference to the value in the Table. Make similar clarification for the latter sections. *In this instance, the flow arriving at the downstream station has been reduced by 27%, which is called a loss in this document. The language of the document has been reviewed and revised as suggested.*

The elevations listed for El Vado Dam in Table 31 are not consistent with the elevations in Table 33. *These data have been reviewed and corrected*

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Are the data in Table 36 monthly or daily leakage rates? Does the information below Table 36 agree with the table? *The data in Table 36 are daily rates. The text has been clarified to avoid this confusion. The discussion following Table 36 describes the development of an estimate of the amount of the gross seepage that is returned the Rio Grande via the riverside drains.*

It is probably not appropriate to show discharge data in Table 39 to the nearest 0.0001 cfs. *Data in this table has been reviewed and revised as suggested.*

Page 48, Jemez Reservoir. The graphs referred to on this page, nos. 121 and 122, do not appear be the correct representation of the Jemez River reach. On these two graphs, the measured discharges reach up to 6,000 cfs, while the time lags in Table 50 do not consider flows in that range. Also, the peak instantaneous discharge recorded at this station was 5900 cfs, Graphs 121 and 122 appear to show many measurements at a discharge of about 6000 cfs. *The data used to develop the equations in these graphs have been reviewed and revised to correct these equation.*

Page 49, first paragraph. The last sentence in this paragraph is unclear, and it is suggested that this sentence be reviewed. A reference to specific graphs may help the explanation. *The R^2 values for non-zero intercepts for other months are also somewhat similar to zero intercept R^2 values. In addition to the R^2 values the slope of the trend line better represented the distribution of the data for the non-zero intercept trend lines. The text has been modified to better explain using non-zero intercepts..*

Page 50. Table 52 shows canal seepage rates increasing over time from 1975-1993 for the Angostura to Albuquerque reach. At some point, these rates will level off. What is the relationship being used in RiverWare? If canal seepage for this reach is based on a linearly increasing relationship, the canal seepage rates should be reviewed. Canal seepage rates have been reviewed and revised.

Page 56, San Acacia to San Marcial routing. What is the rational or basis for using the 1970-1984 period for determining travel times, but a different period, 1987-1996 for monthly loss coefficients. Is this an inconsistency? The data have been revised to use consistent periods of record.

The RiverWare workspace layout for this reach of the floodway (San Acacia to San Marcial) shows an channel seepage or groundwater loss, yet there is no mention of this in text. The workspace layout also shows modeling for the LFCC and the Socorro main canal, which is not discussed in the documentation. RiverWare modeling for this reach has been revised and expanded, and the text has been revised.

Page 57, second paragraph. Is it possible that the time lag had to be adjusted from the lag determined using the standard method because the period used to establish the time lags is not representative of channel conditions during the 1987-1996 period? Channel aggradation in this reach during the 1987-96 period may have reduced the stream velocity from those experienced during the 1970-84 period. Also, it is not clear if the time lags shown in Table 59 are the adopted time lags used by RiverWare. *The methods used to develop travel times for this reach has been adjusted and now includes a hydrograph adjustment technique based on an evaluation of the standard error of the estimate.*

Page 57-58 – San Marcial to Elephant Butte Reservoir. The period of record used to determine travel times (1970-1984) is not the same as the period of record used to determine monthly loss rates. The monthly losses were determined during a period of nearly full reservoir stage, while the routing parameters were developed using data from a period of widely fluctuating water levels. This inconsistency should be addressed, or a basis provided for using different periods of record. *The period of record used in the development of loss rates and travel times has been made consistent.*

A description of the methods used to estimated sediment inflow to Abiquiu, Cochiti and Jemez Reservoirs between sediment surveys should be added to the documentation. *A detailed description of the sediment inflow equations and their application may be found in the accounting model documentation.*

Page 61, It is suggested that the equation

$$“S_t - S_{t-1} - I - P_t - E_t + O = 0”$$

be rewritten as

$$“S_t - S_{t-1} – I_t*1 - P_t *1 - E_t *1+ O_t*1 = 0”,$$

where “1” is one day, and inflow (I_t) and outflow (O_t) vary with time. *The equation as written has been reviewed and has shown to be correct.*

Page 61, it is suggested that the equation

$$“P_t = R_t/(A_{res})”$$

be rewritten as

$$“P_t = R_t*A_{res}/12”.$$

The Document will be changed in accordance with this suggestion.

Page 61, it is suggested that the equation

$$“E_t=E_p/12(coeff)(A_{res})”$$

be rewritten as

$$“E_t=E_p*coeff*A_{res}/12”$$

to avoid confusion. *The Document will be changed in accordance with this suggestion.*

Methods and procedures

The document notes that data point outliers were removed from some data sets. The document should provide a basis for determining which data points are outliers and subject to exclusion. *All data were reviewed and if, in the judgement of the individual working in that reach that the departure is obviously erroneous, the data point was removed from the analysis. The Document will be edited to include this discussion.*

Page 6, section “Reach loss …”, item 1, what is included in the overall data set? Can some data be listed as examples? *The text of the Document will be revised to include as more complete discussion of the data sets used and how they were selected. In* *general, for the reaches above Cochiti Dam, the entire available record (in electronic format) was used to develop travel times. This same period was used in the determination of monthly loss rates. This is a valid approach because most of the channel sections above Cochiti Dam are relatively stable, and travel times and loss rates will not be significantly impacted by using any specific period of time. For the reaches below Cochiti Dam, the channel is unstable and has changed since the construction of Cochiti Dam, and is continuing to change. Using data from the period prior to construction of Cochiti Dam for travel times and loss rates would not be valid for application outside of the period used to develop the parameters.*

The validation period has not been used as yet for the comparison outside of the calibration period. For the URGWOM reaches through the middle valley, the data set selection should include a discussion of the period of record used for the calibration period and the validation period. *Model verification has been undertaken using the 1998-1999 period, and the results of the verification are included in the Documentation.*

Page 22, travel time lags, Otowi to Cochiti (graph 95). Is reservoir operation accounted for in developing travel times for this reach? *The effects of the construction and operation of Cochiti reservoir preclude the use of an additional (downstream) gage to develop travel times. Since the travel time for this reach is based on one gage upstream, the operation of Cochiti Reservoir is not relevant.*

In the development of the monthly loss coefficients in the various reaches, the decision as to use the loss equation with the y-intercept, or to use the loss equation with y=0 intercept should be based on the confidence intervals of the intercept and the slope; that is $p<.05$. Based on work done by others, regression equations will give an intercept value, but because of the large number of values that fall outside the 95% confidence intervals (± two standard deviations), the intercept is not significantly different that zero. *The document has been revised to show only the y=0 intercept in the various loss equations.*

Channel shifting at the gages Rio Grande below Taos Junction Bridge and Rio Grande at Embudo over a period of measurements impacts the travel times of the reach. Identify years in the data plot to determine when channels shifts took place, and develop regression equations for a specific period of years. This will eliminate the effects of channel shifting on travel time. *This exercise could improve calibration of the model, by using separate travel times for specific periods of time. The improvement of the precision this would bring to the model may not justify the work. Since the model cannot predict the location or the nature of future channels, there would be no guidance as to which regression curve to use. Given enough time, future channel location and characteristics will mimic the historic conditions. See also the discussion on page 17 of the text. In some instances, travel times are calibrated by changing reach lengths where differences between computed and observed are significant.*

Page 36, second paragraph (graphs 100-107). How was this data obtained? Width of measurement minus non-flowing (sand bars) should be used to determine average flow depth. The equation in graph 103 should not predict less depth with stage increase from gage height = 1.5 to 3.0. *Flow depths for gage heights less than 3.0 feet will be set equal to the flow depth for 3.0 feet.*

Because these plots reflect continuous shifting and aggradation and degradation, plotting channel change with time is probably necessary. The binomial fitting curves of depth versus stage is not reasonable. *This method of curve fitting was utilized because it produced the best regression equation (highest value of R^2).*

Page 56 – 59 (graphs 126-137,138,149). Use the regression that has both slope and /or intercept significance ($p<.05$). Better relationships between sites will be realized if total flow at one cross-section is related total flow at another without regard to where the water is conveyed to: the floodway, the conveyance, and/or the main canal. *The Floodway only is used to route flows between San Acacia and San Marcial because there is not adequate data to route and account for loss in flow in the low flow conveyance channel in this reach. Routing methods used for routing flows in the Floodway are the same as used in upstream and downstream reaches.*

M E M O R A N D U M

July 31, 2001

To: Members, URGWOM Technical team
From: William J. Miller, Consulting Engineer
Subject: Proposed Responses to Comments on February 27, 2001 URGWOM Documentation

This Memorandum contains suggested changes to the February 27, 2001 URGWOM Technical Review Committee documents and related Appendices. These changes are being suggested as the result of comments received following the April 26, 2001 Technical Review Committee meeting as well as the result of routine review by Technical Team members. Short editorial changes to correct the documentation are included in this Memorandum; lengthier changes are contained in documents attached to this Memorandum. Minor changes made to correct errors in grammar, punctuation or for the sake of clarity are not identified here. This Memorandum also contains proposed responses to comments made on URGWOM documentation that may not result in changes to the documentation.

Changes to documentation made in response to comments

An introduction that describes all of the model documentation, including the appendices, should be included. See attached document entitled "Model Document Introduction".

The model limitations must be assessed, clearly identified, stated in the model documentation and strongly communicated to potential model users and to the water management community. The following language have been included in the introduction to the URGWOM documentation to address this comment:

> URGWOM is intended to be developed and operated with accuracy sufficient to represent all significant influences to the extent that available data will allow. Lack of adequate physical data or poor data in many areas precludes the precise, reliable simulation of many physical features operating in the Rio Grande basin. In these cases, URGWOM uses the best available data, which in some cases is the only available data, to simulate physical processes. Some of the simulations require data extrapolations that but for the lack of other suitable data, would not normally be done. URGWOM development serves as a tool for identifying areas where additional data or investigations are needed.
>
> URGWOM is not a water supply model, a climate simulation model, a water rights model, a rainfall/runoff model, a hydraulics model or a groundwater model, although some of these things may be used as input to URGWOM or receive output from URGWOM. The user of the data and relationships developed in this model and documentation is cautioned against applying the relationships outside of the range of data upon which the relationships were developed. Care should also be exercised in the use of applications involving high or low-flow extremes. For example, see Graph 145 in appendix A. In this instance, the lack of reliable low-flow measurement data has resulted in computed travel times varying between 25 hours and 60 hours for the flow of 300 cfs.

Physical Model Document (02/27/01 Draft):

Page 1. Introduction. Add new Figure 1, a map of the Rio Grande basin between Lobatos and Ft. Quitman, that shows the entire geographic extent of URGWOM in one location. Re-number subsequent figures.

Page 1. Add a fourth paragraph under the INTRODUCTION as follows:

> Data sets used to determine travel times and loss rates for the reaches above Cochiti Dam and travel times for the reaches between Cochiti Dam and Elephant Butte Dam are from USGS stream-gage calibration data and Bureau of Reclamation and Corps of Engineers' reservoir records. Data from gages at the upstream and downstream ends of URGWOM reaches that are available in electronic format, which is generally the most recent 30-year period, were used in these calculations. Data sets used to determine loss rates and travel times for reaches between Elephant Butte Dam and El Paso are based on stream-gage calibration and reservoir data collected by the USGS, Bureau of Reclamation and Elephant Butte Irrigation District during the 1984-99 period.

Page 3, fourth paragraph, fourth sentence. Delete this sentence and insert the following sentence in lieu thereof: "First, the variable time lag method is fairly easy to develop if measurement data are available. Second, it can be developed throughout the model for reaches with differing geomorphic and hydrologic conditions."

Page 5, Figure 1. Edit (if possible) the equation in the graph to read: $A = 9.5789Q^{0.517}$.

Page 5. In the last equation on this page, add units of miles (mi) after 28.8, and add units of velocity (ft/sec) after 3.25.

Page 8, RIO CHAMA REACHES. Prior to the single sentence referring to figure 3, insert the following:

> A 73.4-mile section of the Rio Chama is divided into two reaches. The first reach begins at the gage Rio Chama below El Vado Dam and extends to the next downstream gage Rio Chama above Abiquiu Reservoir The second reach is from below Abiquiu Dam downstream to the Chamita gage, which is considered the confluence of the Rio Chama and Rio Grande. The San Juan-Chama Project water diversion and delivery into Heron Reservoir is included in the physical model. The transport of San Juan-Chama Project water from the Azotea Tunnel portal to Heron Reservoir is not based on physical gains/losses and lags, but is based on an approved loss rate of 0.002 with no travel time lag.

Page 13, After the heading UPPER RIO GRANDE REACHES, add the following new paragraph:

> The 132-mile reach of the Rio Grande between the Colorado-New Mexico stateline and Cochiti Dam is divided into six reaches. The first reach begins at the gage Rio Grande near Lobatos, CO, the second at the gage near Cerro, NM, the third at the gage below Taos Junction Bridge, the fourth at the gage at Embudo, the fifth at the Rio Chama confluence and the sixth at

> the gage at Otowi Bridge. The discontinued gages Rio Grande above San Juan Pueblo and the Rio Grande near Arroyo Hondo were used to help estimate travel times and loss rates in the reaches where the gages formerly operated.

Page 29, last sentence. After the word "topology" add "(Appendix B)".

Page 32, Delete paragraph number 11.

Page 38, Table 36. Delete the word "monthly" from the caption of this table.

Page 53-54, Table 53. Middle Rio Grande Conservancy District total irrigated-crop acreage, 1975-99. Data errors were found in the miscellaneous fruit, miscellaneous vegetables and hay columns of this table and have been corrected.

Page 60, first paragraph found at the bottom of the page, third sentence. More recent data about irrigated acreage for the La Joya Community Acequia provided by the NM Interstate Stream Commission indicates that up to 250 acres may have been irrigated in 2000. As a result of this new information, an agricultural depletions object to the Bernardo to San Acacia reach will be added to account for agricultural depletions associated with 250 acres of irrigated farmland served by the La Joya Community Acequia. The third sentence in this paragraph will be revised to read as follows: "Based on 2000 NMISC GIS irrigated acreage data, irrigable acreage in this reach was assumed to be 250 acres."

Page 63, under the heading **Computation of Local Inflow**. Delete this paragraph in its entirety and insert the following in lieu thereof:

> The local inflow, which represents the gains or losses within the reach, is determined by subtracting the routed with losses flow from the downstream observed or recorded flow (exact local inflow). Assuming proper modeling techniques and accurate stream gaging, the routed with losses hydrograph should be contained within the observed hydrograph and the difference between the two is an estimate of the local inflow occurring between the upstream and downstream stream gages. The resulting accepted local inflow data set is intended for use as input in the planning and water operations models. The following items are represented in local inflow which could not otherwise be accounted for:
>
> - Ungaged diversions and return flows;
> - Precipitation;
> - Ungaged tributary inflow;
> - Streamflow measurement errors;
> - Modeling errors;
> - Ground-water interaction

Page 69, PHYSICAL DESCRIPTION OF MODEL REACHES. In the first sentence, delete "Courchesne Bridge" and insert in lieu thereof "stream gage Rio Grande".

Page 71, under heading **Reach Travel Time and Loss Analysis**. Paragraph number one, second sentence. Insert "and loss rates" after "travel times".

Page 77, Table 76. The Adopted loss coefficients for the flow range above 2,000 cfs should be 0.05.

After page 79. Insert attached write-up entitled "Reservoirs in the Lower Valley."

Appendix B

Delete this copy (dated 7/06/00) of URGWOM RiverWare workspace layout and insert in lieu thereof the most recent version of the workspace layout that includes URGWOM reaches between Elephant Butte Dam and El Paso.

URGWOM Physical Accounting Model Documentation

Page 1, Table 1. The loss rates for the reach Cochiti to Elephant Butte should be corrected to read as follows:

Month	Loss (%)
January	3.30
February	3.80
Mar	5.20
April	6.50
May	7.20
October	4.60
November	3.70
December	3.30

Proposed responses to comments not resulting in changes to URGWOM documentation.

The following comments, along with proposed responses, have not resulted in changes to URGWOM Documentation and are made to document the response to the comment. The comments are summarized prior to providing the proposed response. Responses are given in *italics*.

Key long-term transient impacts relate to climate cycles and population growth, both of which impact ground-water withdraws and recharge conditions, cannot be modeled in URGWOM.

This is indeed a limitation of the URGWOM physical model as well as other physical surface water models. URGWOM is based upon historical physical data, which in some cases includes the effects of long-term (30 year) climate influences and population growth. The basic assumption used in this instance is that future hydrologic conditions will reflect historic conditions. URGWOM is not a climate change forecast tool. At such time as a better understanding of climatic dynamics is reached, or better data or tools become available, these factors may be included in river simulation models such as URGWOM.

The model needs to improve representation of parameters that impact water conveyance in the middle valley.

One of the benefits of developing the URGWOM physical model is that the model complexities have resulted in the identification of areas of data limitation which has resulted in the identification and prioritization of additional data needs. Data parameters, such as irrigation drain return flows from irrigated lands in the middle *valley, are now being measured for the first time in some instances. When a sufficient data base of drain returns become available for use in URGWOM , improvements in the model's reliability can be expected. This type of data enhancement will be incorporated in future URGWOM enhancements.*

Page 2, Table 1 implies the use of the Muskingum K value of 0.1, but the text above the table uses a value of 0.3. *The Muskingum X value of 0.3 was tried in RiverWare, resulting in negative flows. Because of the instability of the method for short routing reaches (travel times less than 24 hours), the X value was adjusted to 0.1 so that negative values would not be computed. See text on page 2 located immediately above Table 1 in 02/27/01 draft.*

The text and the graphs found in appendices should use the same number of significant figures in the equation coefficients and R^2 values. *Coefficient of determination values (R^2) used in the text in the tabulation of stream-gage and calibration data and for the loss rate correlations for the various reaches are presented in two significant figures. The number of significant figures used in the R^2 values found in the graphs in Appendix B are "hard wired" in the MS Excel spreadsheet program.*

Many figures and tables in the text have different period of record than suggested for the calibration period of 1985-1996. *In the reaches above Cochiti Dam, stream-gage calibration data and related loss rate correlations are based on the period of record defined by gage calibration data available in electronic format. This is generally the most recent 30-year period, depending upon the individual stream-gage. The gages above Cochiti Dam used to determine loss rates and travel times are located in stable channel sections and provide the largest amount of data that is considered reliable during the calibration and validation period, and travel times and loss rates are not substantially affected by the use of any specific period of time. For those reaches below Cochiti Dam, the channel is unstable: the channel has changed since the construction of Cochiti Dam and continues to change.*

Outliers have been removed in some sets of data. Was there a method to select them? Should other data be outliers? *Data points removed from the data set were points that, in the judgment of the modelers working on that analysis, were clearly based on erroneous data and were not located close to the remaining data points or the "line of best fit." In general, data to be used in an analysis were plotted using a log-y axis. This allowed plots of the outliers to be exaggerated and selected for removal.*

What does the information in table 6 really describe? Graphs 11 through 22 in Appendix C have two sets of lines in them. *In all of the tables describing the loss rate correlations, the "n" value is the number of days that remained after application of the screening process, the "slope (y=0)" column is the slope of the "line of best fit" based on a regression equation with a zero y-intercept. The R^2 value is the coefficient of determination from the "line of best fit" equation using a zero intercept, which is the percentage of the variance of the dependent variable that is explained by the regression equation. The "Adopted monthly loss coefficient" is the result of the equation [{slope (y=0)} – 1.0]. Some of the graphs show two lines of best fit, those with a y-intercept and those without. Based on comments received during the January 26, 2000 technical review, it was determined that there is no significant difference between the with and without y-intercept relationships, so the y=0 relationship was adopted for simplicity. In the Lower Valley reaches, the y=0 and the y-intercept equations showed significant* *differences in some reaches in some months. Equations with non-zero intercepts were adopted when they improved the relationship (as described by R^2) by 4% or more over the zero-intercept relationship.*

Tables 7 through 12 use different periods of time. *The period of record used in determination of the loss rate correlations are different from the period of record used in the travel time determination because the days that remain after the application of the 3-consecutive day screening period may result in varying periods of time for each reach, depending upon the results of the application of the screening process.*

The stream-gages Rio Chama near Chamita and Rio Grande above San Juan Pueblo have been assumed to be the same position on the river. *There are no gages on the Rio Chama at is mouth or on the Rio Grande at the confluence with Rio Chama. For the purposes of determining travel times and loss rates, the gage Rio Chama near Chamita (2.8 miles above mouth) was assumed to be at the confluence, and the gage Rio Grande above San Juan Pueblo (1.8 miles above Rio Chama confluence) was assumed to be located at the confluence of Rio Chama and Rio Grande.*

What was the recognized acceptable R^2 value? *No criteria have been established for which an R^2 value was determined to be acceptable or not. The R^2 value is presented to allow for the evaluation of how good the relationship predicts the dependant variable. In the development of these relationships, it was found that although there may be a poor (low) R^2, the relationship is based on the only data available.*

Is the definition of "standard error" found anywhere in the documentation? *The MS Excel spreadsheet software was used to compute the standard error. The MS Excel spreadsheet software defines the standard error as the measure of the amount of error in the prediction of y for an individual value of x.*

Does the information below Table 36 agree with the table? *The text located below Table 36 is not discussing the data in Table 36. Table 36 discusses estimates of the total amount of water seeping through the bed of the river, the text below the table discusses the derivation of the amount of seepage that is intercepted by the riverside drains.*

What is the variable time lag method? *The description of the variable time-lag method is found on page three, and development of the method is found under the heading "Time Lags Base on Wave Velocity".*

Does standard error relate to R^2 throughout the document? *The standard error is not always related to R^2. The standard error is related to confidence intervals on the regression line. MS Excel spreadsheet software was used to compute the R^2 value. The MS Excel software spreadsheet as uses the correlation coefficient (R^2) to determine the relationship between two values.*

What criteria are used to drop data points to decrease the "standard error". *No data points are lost in the process of minimizing the standard error. Some data points may have been dropped in the initial development of travel times using the variable time lag, if in the judgment of* *the modeler, there were obvious errors. The standard error is minimized by multiplying the travel time lags by various multipliers greater than or less than one.*

Why do the estimates of canal seepage not change between 1975 and 1999 except for the San Felipe to Central reach? *These data are derived from Bureau of Reclamation data and reports. (1997 Middle Rio Grande Water Assessment – Supporting Documents 6, 12 and 15) These documents present the data used in the RiverWare model, but do not provide any information about the variations in canal seepage rates. Table 52 has been reformatted to try to make the information presented easier to follow.*

Use of a pan coefficient of 0.7 is not valid for use at all reservoirs during all months and its source should be referenced. *Agreed, however, water accounting is based on the use of pan coefficient of 0.7 as approved by the Rio Grande Compact Commission. Evaporation pan coefficients used to compute water surface evaporation may be varied by reservoir for use in the Water Operations or Planning models.*

There is no written description of the hydrogeology of the Lower Valley (as found in the Middle Valley section) *Only simplified modeling of flood flows is done in the Lower Valley reaches of the Rio Grande, which does not require a section on descriptive hydrogeology. When the Lower Valley is modeled in detail a corresponding description of the Lower Valley hydrogeology will be written and included in the report.*